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Anxiety in the testing situation arises out of the evaluative nature of the testing procedure. Anxiety is a factor in performance. The study involved 152 first grades with IQ's between 100 and 125.

All subjects were given the Test Anxiety Scale for Children and the General Anxiety Scale for Children, after which they were divided into four groups. The Pictorial Test of Intelligence (P.T.I.) was administered to each group, including a picture vocabulary, form discrimination, information and comprehension, similarities, sizes and numbers, and immediate recall.

The apparatus used to record physiological behavior in terms of skin resistance was a Lafayette Multipurpose Polygraphy Recorder. All tests were given to all subjects by the same examiner and were given in testing rooms in the schools where the subjects were enrolled.

Findings show that test items arrangement will not be a critical factor in the behavior of similar groups of first grade children responding to similar tasks, but may be a factor for some individuals within the groups.

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EFFECT OF TEST ITEM ARRANGEMENT ON THE PHYSIOLOGICAL AND PSYCHOLOGICAL BEHAVIOR IN PRIMARY SCHOOL CHILDREN

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Cooperative Research Project 2141

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
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J. L. F.

D. R. G.

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Chapter 1

Introduction

This study was undertaken as a result of a growing concern about the effects of stress generated during the intellectual assessment of children. The purpose of this study is to investigate the effects of test item arrangement on the physiological and psychological behavior of children enrolled in the first full year of school. Current techniques of intellectual assessment are many and varied but in recent years, particularly since the advent of the National Defense Education Act of 1958, standardized tests have been used more widely each year. From time to time various instruments have generated cycles of enchantment and disillusionment as their merits and faults have been discovered. This cyclical swing may be due in part to the limited knowledge of test users concerning the factors which effect the validity of scores.

All too often the criticism is raised that a given index does not properly reflect the ability of each examinee. Educators have long been aware that discrepancies exist between optimum and measured performance and some have become disenchanted with the use of tests due to discrepancies found in a few instances. Frequently tests have been used with little or no concern as to the possible factors

which may influence an individual's performance in a specific testing situation.

Test developers have been cognizant of the fact that certain extraneous factors hinder the achievement of the examinee and have attempted to institute procedures which will reduce the dehabilitating effects of these factors. Of great concern to test authors are the factors which may be inherent within the testing situation itself. Some examinees may experience trepidation in a specific setting. To overcome the dehabilitating effects of this diffidence, suggestions have been offered in the literature as to how the examiner may alter his behavior in order to offset this effect. This alteration of behavior is often subsumed under "establishing rapport." The success of this procedure, however, pivots around one crucial element--the skill of the examiner in recognizing a loss or lack of rapport and his ability to do something to establish sufficient rapport to proceed.

It is not reasonable to expect that all those who use standardized tests are equally skilled or equally competent. Varying degrees of skill may be due to varying quantities of knowledge or concern on the part of some test users. They often fail to notice or have any concern about the influence of apprehension on the examinee's performance.

If, then, it is not possible to insure that rapport will be established in all testing situations, is it possible to modify the test situation so that rapport is easier to maintain? Specifically, the study reported herein is directed to determine whether a test may be altered to reduce the effects of apprehension and still properly assess the ability for which the instrument was devised.

Before proceeding further it is necessary to present certain terms which have specific meaning in this study and recur frequently enough to warrant their defining. The definitions below are based upon those presented in English and English (1958).

Definitions

Point scale - "A group of test items or problems to each of which a numerical credit is given for success." (p. 396) The score is based on the total points amassed.

Spiral omnibus test - "A test in which the various kinds of tasks are distributed throughout the test instead of being grouped...by kind and...are arranged in a recurrent pattern...of increasing difficulty." (p. 548)

Anxiety - A feeling of threat from anticipation of future harm.

Stress - Psychological force or forces which places the individual under emotional "strain or distortion in the system." (p. 529)

Tests - "A set of standard or controlled occasions for response presented to an individual with design to elicit a representative sample of behavior when meeting a given kind of environmental demand." (p. 547)

Keeping these definitions in mind, the problem of modifying a test to reduce the anxiety of the examinee may be more fully explored.

One of the most obvious ways of reducing the difficulty of a test and hence the apprehension of the examinee would be to give a test on which the individual would not encounter any difficulty. All items would be well within his ability to respond correctly. This procedure would eliminate any anxiousness which might be generated by the test but would not afford an adequate measure of his ability. It would be known that his performance was at least that of the limit of the instrument. However, such an instrument would not properly test the limits of his ability, particularly the upper limit. Such an instrument would have an inadequate "ceiling." It would not be possible to predict, with any degree of certainty, how much more could be expected and, as a result, the above procedure would not be

feasible. With this possibility eliminated, the arrangement of the items of varying degrees of difficulty within the test was considered.

Item arrangement within a test follows, in the majority of instruments, one of two major patterns: increasing order of difficulty within subtest or a modification of a spiral omnibus arrangement. There seems to be little agreement among test constructors as to which method is best and the use of one or the other seems to depend primarily on the personal preference of the particular author. Either of these two methods seem to serve the purpose of assessment equally well but there is little research to support the use of either arrangement or, for that matter, any other arrangement. This finding led directly to the consideration of item arrangement in connection with the anxiousness experienced by the examinee in the test situation.

In observing test situations it has been noted that many examinees show more outward signs of anxiousness as they encounter items which are more difficult for them. As subjects approach the upper limits of their ability to correctly perform, failure occurs with increasing frequency until a point is reached when no item is successfully completed. Thus the "ceiling" is reached for that particular individual. Along with this increasing failure it has been noted that the outward signs of the examinee's discomfort

alsc increased. Perhaps if the stress were not so great the examinee may have answered more items correctly.

If the examinee's recognized failure could be mixed with periods of recognized success, could the accompanying total amount of anxiousness be reduced also? If the items could be arranged in such a manner so the testee would experience some success throughout the entire test, rather than a period of success followed by a period of failure, perhaps anxiousness about his performance could be reduced to a level where it would not reduce his effort or accuracy of performance. If this were possible, then anxiousness and the accompanying loss of rapport could be minimized and perhaps the index of his ability derived from the test would more accurately reflect his potential performance. By arranging the items so that probable success would surround those items on which probable failure would occur, it would be possible to assure that some success would be encountered within any given group of items throughout the entire length of the test. As this order of arrangement was considered in detail other possibilities were suggested.

Clinical experience in testing situations again served as a guide-line. Some individuals seemed to be more anxious with regard to certain types of tasks than others. In the traditional subtest arrangement, items of the same kind are placed together and in increasing order of difficulty.

While this has the advantage of allowing the testee to go from easy items to difficult items and then back to easy items throughout the test, some examinees seemed to express more anxiousness during a numerical subtest or those requiring skills of perceptual organization than during other subtests, while others seemed to express more anxiousness during highly verbal subtests. The spiral omnibus order of item arrangement reduced the length of time an examinee would be exposed to a type of task in which he has some expectations of failure.

Two points of consideration for the arrangement of the items within a test have been described; one dealing with the placement of items to assure some feeling of success at given times throughout the test and the other dealing with the heterogenous arrangement of items so as to reduce the concurrent time that the individual will be exposed to any particular type of task within the testing situation. The present study is concerned with these two points. The investigation deals specifically with the effects on subject behavior of four different arrangements of items within a new point scale designed to measure intelligence. The four arrangements are:

1. Published order - items arranged approximately in increasing order of difficulty within subtests.

2. Absolute order - items arranged in increasing order of difficulty within subtests according to the standardization data.

3. Random order - items placed randomly throughout the test without regard to subtest or item difficulty.

4. Patterned order - items placed in a sequence of two easy, one hard throughout the test without regard to subtest.

With these four arrangements the effects of subtest and item arrangement may be studied. The general hypothesis is that no difference will be found in intelligence scores as measured by a point scale, in behavior as observed and recorded by an examiner when the items are presented in the different orders, or in physiological reaction as measured by a galvanometer.

The assumptions and limitations which have been accepted in connection with this study should be stated at this point.

Assumptions and Limitations

One of the first assumptions that was made in this study dealt with the function of anxiety in relation to the testing situation. It was assumed that there was a certain amount of test anxiety present in all individuals in the testing situation. It was further assumed that such anxiety would be related to test performance. It was also assumed that if anxiety does exist in some degree it could be quantified and some index be derived to indicate its presence or absence in the individual at any given time.

Other assumptions concerning the test instruments were made. A major assumption was that each item contributed the same weight to the total score regardless of where it was placed in the order of items. An item was assumed to measure that portion of behavior completely unrelated to the sequence where it was placed. This assumption is common to all point-scale tests. The item will reflect the same amount of contribution to the total assessment as any other item regardless of the difficulty of the item. An easy item for the individual contributes as much to his total score as does a difficult item. The value of an item as a unit of measure is completely unrelated to the other items within the test except as they are summed to give a total score.

It was also assumed that the difficulty of the items was unrelated to the sequence of items in the test and that item difficulty as determined under standardization procedures was an adequate reflection of the difficulty of that item for any subsample of the population in general. This assumption basically is one of sampling and involves two parts. One, that the standardization sample was truely representative of the population as a whole; and two, that any subsample drawn from the total population will not differ in any significant manner from the population as a whole and, therefore, not from the standardization population. In this circuitous manner we are assuming that an item would be as difficult for any sample drawn from the general population as it was for the standardization sample. Since this can only be determined subsequently it must be assumed antecedently.

The above assumptions were necessary before any study could proceed and, therefore, were not considered to be a deterent to the investigation. However, it is fully realized that certain limitations must be imposed on the results. For this reason certain limitations were inherent within the study and they will be listed below.

Perhaps the most important limitation of any study is that of the representativeness of the sample. The results of this study can be applied only to groups similar to the

particular group with which the study was conducted. Only in those characteristics which the group does not significantly differ from the general population can there be any generalizations made from this study.

There is a limitation dealing with the generalization from the instrument used for assessment of intellectual ability. It was necessary to choose a point scale type of test in order to satisfy some of the above assumptions. The findings in regard to this point scale can only be limited to the particular scale and it is not intended that it be representative of all point scales of intellectual assessment. The findings may generally be hypothesized for tests of the same type in as far as they satisfy the above assumptions as to independence of items. However, similar studies should be conducted verifying the hypothesis.

A futher limitation is that all examiners may not be as familiar with the instruments and apparatus which were used in this study as the investigators who conducted this study.

In this chapter the need for the study has been established and the problem has been identified. In the following chapter a theoretical position will be proposed and the literature reporting studies involving the methods of measurement of anxiety and those reporting the relationship between anxiety and task performance will be reviewed.

Chapter 2

Related Literature

In recent years a great deal of research has been conducted concerning the relationship between anxiety and various types of performances. As a result of this increased interest in the relationship of anxiety and performance, particularly intellectual functioning, some concern has been expressed about the nature and origin of anxiety. In order to bring the important factors into clearer focus, an attempt will be made to summarize the literature dealing with anxiety in testing situations.

Most investigators feel that in order to adequately define anxiety it is first necessary to separate anxiety from other emotional states which are present in the organism from time to time. One of the emotional states which is often considered closely related to anxiety is fear. Often these two concepts are used interchangably but Leavitt (1957), in his review of the topic, takes a very different position. He makes a clear differentiation between fear and anxiety. Fear is an emotional state incurred when a certainty exists that danger is a present threat to the organism. Anxiety on the other hand can occur only when an uncertainty exists as to whether "suffering" will occur. Later he states that what the conscious ego preceives as

anxiety "seems to be an expression of uncertainty by the unconscious portion of the ego as to whether the repression mechanism and/or other ego defenses will hold fast to prevent an instinct presentation from reaching consciousness." (1957, p. 70)

Leavitt's position is one which would generally be accepted by personality theorists but there is some disagreement between the personality theorists and the S-R theorists as to the nature of anxiety. Whiteman (1957) believes this schism exists only because of different ways of viewing the same mechanism. He points out that the S-R theorist stresses the relationship of signals of noxious stimulation to anxiety whereas the personality theorist views anxiety as a reaction to threat, danger, or trauma. Whiteman attempts to close this schism by taking the position that anxiety is a function of frustration; frustration which occurs because of what he terms an "adaptive lack" on the part of the organism under varying states of drive. This position should satisfy both groups of theorists in that it shows the relation to drive as espoused by the S-R theorists and is closely related to the position taken in Leavitt's review. The "adaptive lack" would occur because there is not a clear certainty that "suffering" will occur; hence, only a vague threat to the organism.

Since the relation of anxiety as it is evidenced in the testing situation is the focal point of the present study, a brief consideration of current test anxiety theory will be presented here.

Sarason, S. B., Davidson, D., Lighthall, Waite, and Ruebush (1960), after a study of test anxiety in children, felt that anxiety is generated in the child because of the evaluative nature of the situation which exists between the child and his parents. During the child's growing years, he is constantly being evaluated by his parents. This evaluation gives rise to feelings of either hostility or aggression on the part of the child toward his parents. Because of his subservent position to his parents, he is not allowed to give free expression to these feelings. In order to avoid either physical or psychological punishment he tends to repress these feelings. The psychoanalitic position holds that repressed material threatens to break through to the conscious level. Thus, the uncertainty of the "suffering" stated by Leavitt exists. Stanley-Jones (1957) tends to support this concept. He states that "anxiety is quantitatively due to aggression that has been repressed...."

The theoretical position of Sarason, S. B., et al., and Stanley-Jones receives some emperical support from a study conducted by Learmonth, Ackerly, and Kaplin (1957). They conclude that: "...response to stress is correlated

positively with a group of personality variables that have in common restraint and curtailment of unpleasant or prohibited feelings or actions." (p. 157)

According to the theoretical position above, the testing situation has an evaluative nature and, therefore, feelings of hostility or aggression arise. These feelings are repressed and, hence, anxiety is generated.

By extrapolating from this orientation, some interesting possibilities arise. If anxiety arises because of an "adaptive lack" or because an uncertainty exists as to the possible "suffering" on the part of the organism, it would seem that the more complex the task on which the evaluation is made the greater the anxiety. The more complex the task the greater the possibility that there will not be a pattern which will lead to the successful performance of the task within the behavior repertory of the organism. There will exist the possibility of Whiteman's "adaptive lack." Because it is only a possibility, the element of uncertainty may occur and thus Leavitt's uncertainty of suffering may occur.

One other interesting speculation may be made. This deals with the relationship between ego involvement and anxiety. The greater the ego involvement on the part of the individual the greater the possibility of "suffering." If his behavior is nonadaptive, the more his ego integrity may

be threatened. With such threat, the greater may be his resentment, the greater may be the repression and thus the greater may be the anxiety.

With the theoretical position established that the testing situation may generate anxiety within the individual, the areas of anxiety measurement and anxiety and performance will be reviewed.

The subjects of "anxiety" and "measurement" are found in great abundance in the literature. While most of these articles could be related to the current study in some manner, an inclusion of a majority of the research reports would serve only to obscure the purpose of this review. The main concern in the current investigation is the measurement of anxiety and the relationship between anxiety and the testing situation. Recently Merwin and Gardner (1962) reviewed most of the recent literature concerned with test performance and anxiety and Martin (1961) presented an excellent review of the research dealing with anxiety measurement. Although these two reviews present excellent summaries of the research in the two areas, the needs of the current study would be better served if a closer look were taken at some of the more pertinent studies. The specific studies will be grouped into various catagories to facilitate analysis. Following the lead of Merwin and Gardner (1962)

and Martin (1961), the two major divisions will be the measurement of anxiety and the relationship of anxiety and performance. Within these two major divisions will be sub-divisions. The first will contain physiological measures of anxiety and psychological measures of anxiety. The second major division will contain sub-divisions pertaining to anxiety and verbal performance, anxiety and achievement and others.

Measurement of Anxiety

A great variety of physiological varibles have been measured in connection with anxiety and anxiety states. Martin (1961) reported in his review that systolic blood pressure, diastolic blood pressure, heart rate, cardiac output, hand temperature, palmar conductance, respiration rate, frontalis muscle tension, finger tremor and salivary output have all been used by investigators inquiring into the measurement of anxiety. Martin, in the same review, reporting on a theory proposed by Funkenstein, et al., states that they suggest that the physiological reaction accompanying anger directed outwardly is a nonepinephrine-like reaction while the reaction accompanying anxiety is a epinephrine-like reaction. Reviewing the studies conducted to investigate the physiological reactions accompanying injections of epinephrine and nonepinephrine, Martin found

that, in general, epinephrine leads to increased palmar conductance, systolic blood pressure, heart rate, cardiac output, forehead temperature, central system stimulation and blood sugar level. Decreases were noted in diastolic blood pressure, peripheral resistance, hand temperature, and salivary output.

Although a great number of physiological measures may adequately reflect anxiety, practical and ethical considerations of the current study made it necessary to restrict the selection of a measure to those which would be relatively easy to secure, would cause the least amount of discomfort to the subjects involved in the study, and would be relatively uneffected by the erratic movements which are characteristic of the subjects in the study. For these reasons, a palmar sweating measure was decided upon as a physiological index of anxiety. Since this will be the measure used, the literature reviewed will be primarily restricted to studies involving some index of palmar sweating.

Palmar sweating is measured with a variety of techniques and given many lables. In order to introduce some clarity, all references to palmar sweating will be referred to as the galvanic skin response (GSR) and the specific measures involved in each study will be noted.

In most of the studies in which the GSR has been used, some outside index of anxiety has been used concurrently.

These indicies are generally either a scale designed to measure reported anxiety or clinical judgement of anxiety. One other procedure which has been used is to assign the subjects tasks which have been judged to induce anxiety. Two studies which use the Palmar Prespiration Index (PPI) as a physiological measure of anxiety and the Taylor Manifest Anxiety Scale (MAS) as a criterion index, found no relationship between the two measures. Lotsof and Downing (1956) and Calvin, McGuigan, Tyrell, and Soyars (1956) reported no significant relationship between the two measures in the experiments which they conducted. Two other studies using the Palmar Sweat Index (PSI), conducted by Bixenstein (1955) and Rosenstein (1960) reported quite different results. The former investigator found a significant relationship between the density of the PSI and reported periods of stress. Rosenstein found essentially the same phenomena. The PSI showed significantly greater increments for subjects who were placed under stress by instructions from the investigator. In the same study the Test Anxiety Scale (TAS) was also used and no relationship was found between the two measures.

The findings reported in the studies above indicate that the psychometric measures were not significantly related to the measures PPI or PSI. Quite different results

were reported when other physiological measures were compaired with psychometric measures.

McDonnell and Carpenter (1959) found that the skin conductance level was significantly related to scores received on the General Anxiety Scale (GAS). The same results were also reported by McDonnell and Carpenter (1960) in another study they conducted. Raphelson (1957) used the Test Anxiety Questionnaire (TAQ), the MAS and a need achievement scale and found that subjects who were considered relatively anxious (low need achievement scores and high TAQ scores) showed an increase in skin conductance while the group classified as nonanxious showed a decrease in conductance. These differences were significant but there were no significant results when the MAS was used to classify the subjects. Raphelson and Moulton (1958) replicated the aforementioned study with the exception that the subjects had no reference as to the accuracy of their performances. In this study there were no differences between conductance levels in a neutral task and the task designed to induce stress.

Berry and Martin (1957) investigating the relationship between TAS scores and conditioning of the sharp increases in skin conductance found that there was no relationship between conditioning and reported anxiety level. In this study girls were found to be more reactive than boys. Gilberstadt and Davenport (1960) carried out a conditioning

experiment of the sharp increases of conductance and found that the conditioning was different for subjects divided into three groups by clinical judgement but no differences were found when the subjects were grouped according to MAS scores. Bitterman and Holtzman (1952) obtained results which support those of Gilberstadt and Davenport, thus indicating that the clinical index seems to be a better predictor of conditioning than scores obtained from the MAS.

A number of studies using a variety of GSR measures may be broadly classified under the heading of "task induced anxiety." Novak, Moriarty, Koltuv, and Welsh (1956), established avoidance and nonavoidance conditions in a reaction time study. They found that two of the three nonavoidance groups showed lower ohmic resistance than their prestimulus levels but no such differences were found for the avoidance groups.

Using a group of hospitalized male patients, Sines (1957) divided them into three groups on the basis of psychological test and/or interviews. Stimulus cards were selected which would bring into focus the area of conflict for these three groups. The results indicated that the stimuli evoked changes in physiological activity which were statistically significant. The one measure of physiological activity used in this study was GSR.

Percent of conductance change was found to be positively related to the difficulty and complexity of motor tasks in a study conducted by Venables (1956). For the normal subjects used in the study, a decrease in the difficulty of the task was followed by a decrease in conductance but this was not the case for the subjects classified as psychoneurotic.

A continuous mental task was used by Du Tiot (1956). He reported an over-all increase in skin conductance in the majority of the records obtained.

Martin (1959) obtained continuous skin conductance levels during a stressful interview. The subjects took a feeling inventory with three different response sets. There was a significant correlation only for the groups which were instructed to respond to the inventory in terms of how they felt in the last fifteen minutes. There was no significant relationship between the skin conductance and MAS scores.

An Autonomic Perception Questionnaire was used by Mandler, Mandler, and Uviller (1958). The subjects were given three stressor tasks after having been divided into two groups on the basis of the scores received on the questionnaire. Heart rate, pyschogalvanic responses (PGR), respiration, face temperature, and blood volume measures were taken throughout the tasks. The differences between the two

groups were significant for heart rate, PGR, respiration and total reactivity scores.

Five learning sessions for three groups of fourth graders divided on the basis of intelligence scores were used by Ringness (1962). The tasks assigned to each group were kept just above the current ability level for all subjects. Five indicies of GSR were obtained throughout the five learning sessions. These were: mean base level, slope of line, varibility about the regression line, combined height of all peaks of 500 ohms or more, and the number of such peaks. The base levels were seen to decrease with each succeeding task. Sex differences were found for base levels and initial arousal levels. Differences between the groups were found only in regard to base level and slope of base level.

Kimmel and Hill (1961), Gordon, Martin, and Lundy (1959), also found decreases in skin conductance concomitantly with periods of stress that were induced in the subject.

The literature reviewed in connection with physiological measures of anxiety indicate that while some measures of GSR, particularly the PPI and PSI, do not adequately reflect the anxiety present; other measures, particularly skin conductance and skin resistance, seem to consistantly reflect this state. In the next section of the review of the mea-

surement of anxiety, the psychological measures will be given closer attention.

A number of the instruments which have been designed to be psychometric measures of anxiety have been mentioned in the section on physiological measures of anxiety. Those mentioned were: the Taylor Manifest Anxiety Scale (MAS), the Test Anxiety Questionnaire (TAQ), and the General Anxiety Scale (GAS). Others which will receive mention in this review are: the Childrens' Manifest Anxiety Scale (CMAS), Bendig's revision of the MAS, Heineman's revised MAS, the Childrens' Anxiety Pictures, and the IPAT Anxiety Scale.

The scales mentioned above do not constitute a complete list of the instruments which have been used in the investigations reported in this review. Since a description of these instruments is available elsewhere no attempt will be made to describe them here. Rather than engage in a description of scales, a review of the studies in which these instruments have been used would seem to be more fruitful. Therefore, a review of the literature of the effects of anxiety on performance will follow.

Anxiety and Performance

The relationship of anxiety to verbal performance has been studied by a number of researchers. Barnard, Zimbardo, and Sarason, S. B., (1961) investigated the relationship

between anxiety and verbal behavior in third grade children. Matching on intelligence test scores, sex and grade, the subjects were divided into three groups according to scores derived from an anxiety measure. The subjects were again divided into two groups and interviewed under authoritarian and permissive conditions respectively. The high anxious subjects made more references to negative affect under the authoritarian setting than they did under permissive conditions. High anxious males had less forceful voice quality and all high anxious subjects tended to give more concrete answers than low anxious subjects. The high anxious subjects' responses tended to be more incomprehensible than those in the low anxious group.

Sullivan and Calvin (1957), investigating the relation of spoken and written vocabulary to a standardized vocabulary test, intelligence and anxiety, found that the amount of uncommon words spoken during an interview was significantly correlated in the negative direction to the score obtained on the MAS.

Studying the effects of anxiety and situational stress on communicative efficiency, Gynther (1957) found that subjects having low scores on the Welch A Scale were significantly higher on the measure of communicative efficiency than the subjects classified as highly anxious.

Rawn (1958), using the IPAT Anxiety Scale and Grace's Hostility Inventory, found that subjects who were least prone to verbal indication of physical hostility were most prone to show the covert anxiety, while those most prone to verbal expression of physical hostility had the greatest overt anxiety.

The above studies indicate that anxiety may be significantly related to the quality, efficiency, and kind of verbal behavior evidenced by a particular group of subjects and that the degree of influence seems to be an inverse function.

The relationship of anxiety and achievement has been studied frequently. Alpert and Haber (1960) investigated anxiety in academic situations. Using a variety of anxiety measures, they found that specific measures of anxiety more often correlated significantly with the indices of academic performance of college freshmen than did the more general measures.

Studying anxiety, intelligence, and achievement of children divided into three intelligence groups, Feldhusen and Klausmeier (1962) found that the correlations between measured anxiety, intelligence test scores, and achievement test scores were all significant. An interesting finding was that there seemed to be no relation between anxiety and achievement test scores for the group with high intelligence test scores. The authors explained this on the basis that

the more intelligent subject may be able to clearly assess the real and present danger inherent in academic testing situations and, therefore, were not threatened by it.

McCandless and Castenada (1956), studying the relationship between anxiety, school achievement, and intelligence in fourth, fifth, and sixth grade children, found that the more complicated skills such as reading and arithmetic suffered more interference from anxiety than did the simpler mnemonic skills and that the interference was greater for girls than for boys.

Sarason, I. G. (1957b), using a group of college undergraduates as subjects, found the performance on academic achievement measures of a group classified as low anxious on the Test Anxiety Scale (TAS) to be superior to that of a group of subjects classified as high anxious. Also the group lowest on the anxiety measure had significantly better grade point averages than the other group used in the study.

Another study using grade point averages as one index of academic achievement was that of Spielberger and Katzenmeyer (1959). These investigators found, after dividing their sample of college juniors into three groups on the American College Examination (ACE) and the MAS, that grade point average was unrelated to the anxiety measure for the high and low anxiety groups but significantly related to the grade point averages of the middle anxiety group. The inves-

tigators explained this finding on the basis that college work was too difficult for the low ability student and that high ability students tended to do well regardless of the anxiety level. This finding seems to support that of Feldhusen and Klausmeier which was reported above.

Pickrel (1958), using United States Air Force Basic Airmen as subjects, divided them into two groups on the basis of a modified MAS and administered four tests of different types. On the scales measuring the more complex activities, the nonanxious subjects scored significantly higher than the high anxious subjects. This finding is in keeping with that of McCandless and Castenada which was cited above. Anxiety as such seems to effect adults much in the same manner in complex tasks as it does children.

Grooms and Endler (1960) trichotomized a group of male college students on the TAQ and collected academic aptitude test scores and semester, cumulative, and predicted grade point averages. They found a significant negative correlation between TAQ scores and the scores derived from the measure of academic aptitude but no significant relationship between the scores on the TAQ and the grade point averages. At first glance this finding appears to be at variance with those of Spielberger and Katzenmeyer (1959) but they used a general anxiety scale whereas Grooms and Endler used a

scale specifically designed to measure anxiety in the testing situation.

Lawrence (1962) collected scores on MAS, a projective measure of achievement motivation, and the ACE from a group of college students. One half of the group were told that their performance on the ACE was important while the other half were told that the test was given only for the purpose of preparing norms. The group designated as high anxious on the anxiety scale scored significantly lower on the ACE when the test was viewed as important. When the test was viewed as unimportant, anxiety was not related to performance. The investigators contend that stressful situations seem to interfere with successful performance of high anxious subjects on a complex task.

Atkinson and Litwin (1960), using TAS scores as an index of motive to avoid failure, collected scores on two need achievement scales, distances from a goal in a ring toss game, time taken on a course final and the score achieved on the final. They found that subjects whose need to avoid failure was greater than their motive to achieve showed less efficiency or accomplishment than those subjects whose need to avoid failure was less than their need to achieve.

The research reviewed dealing with anxiety and achievement either in academic settings or on tests of academic

aptitude seems to indicate that anxiety is inversely related to academic performance indices such as grade point average and achievement test performance. Anxiety seems to be dehabilitating in complex situations but the dehabilitating effect is not as great among people of superior intelligence as among those of lesser intelligence or among those possessing a higher than average need to achieve.

The relationship between anxiety and performance in the learning situation has received a great deal of study. The learning situations have been varied and the tasks have ranged from simple to rather complex. From the studies in which the MAS was used (Buchwald, 1959; L'Abate, 1959; Sarason, I. G., 1957a; Sarason, I. G., 1956; Sinha and Singh, 1959; Stevenson and Iscoe, 1956), from the studies in which the TAS was used (Sarason, I. G., 1961; Sarason, I. G., 1958; Smock, 1956; Wiener, 1959), and from other recent studies (Silverman and Blitz, 1956; Spence, Farber and McFann, 1956; Castaneda, Palermo, and McCandless 1956; Waite, R. R., Sarason, S. B., Lighthall, Frederick, and Davidson, K., 1958) it has been concluded that anxiety seems to effect the rate of learning, the number of errors committed, and the time necessary to make discriminations. The effects of anxiety seem to be mediated by the type of instructions, complexity of the task, and the progression from easy to difficult items within the task. In some studies the

effects of anxiety seem to be different for males than for females.

The investigation of performance on numerical tasks and anxiety seems to be somewhat limited but a few do exist. Callahan and Keller (1957) used the Childrens' Anxiety Pictures, Goodstein and Farber (1957) used the MAS, Hafner, Pollie, and Wapner (1960) used the CMAS, and Sarason, I. G., (1957b) used the TAQ.

In most of the studies dealing with anxiety and numerical performance, support can be found for the position that anxiety and superior performance on numerical tasks are inversely related.

In a study of reaction time, Castaneda (1956) found that response amplitude of high anxious subjects was greater than for low anxious subjects. The speed of reaction, however, was higher for the low anxious group.

Davidson, W. I., Andrews and Ross (1956) studied the effects of stress and anxiety on high-speed color naming. Having three levels of tasks stress, three levels of failure stress and two levels of anxiety, they found that anxiety served to increase the subjects' susceptibility to the effects of stressful conditions.

Shepard and Abbey (1958) investigated performance on a complex motor skill task as effected by manifest anxiety.

They found that the low anxiety subjects were superior on all tasks to the high anxiety subjects.

Anxiety seems to effect speed of reaction of perceptual motor skills and overall performance on these tasks. As the complexity of the task is increased, the effects of anxiety seem also to increase.

Some investigation has been carried out to make inquiry into the effects of anxiety on abstract concepts. Lipman and Griffith (1960) explored the relationship between anxiety and concept formation with institutional retardates as subjects. Using scores derived from the CMAS to designate the two anxiety groups, the investigators administered a concept formation task within which the subjects were required to report similarities within sets of words. As the abstractions became more difficult, the high anxious subjects' performance was significantly poorer than the low anxious subjects'.

Kerrick (1956) divided her group of high school subjects on the basis of upper and lower quartiles of an intelligence test score distribution. These subjects were then divided on the basis of upper and lower quartiles of the MAS score distribution. With four groups defined, a task consisting of judging a concept against a series of discriptive scales was undertaken by all subjects. The finding indicated an interaction exists between intelligence and anxiety.

With increased anxiety, high intelligence groups tend to become less discriminating while the low intelligence groups tend to become more cautious.

Increased anxiety seems to have an adverse effect on concept formation and concept judgement. The effects of anxiety seems to increase with an increase in the complexity of the task.

A study concerned with perception and anxiety and one dealing with the function of anxiety on a complex reasoning task will provide some interesting results. The study involving perception was carried out by Ruebush (1960). He divided sixth grade boys into three groups on intelligence test scores, into two groups on Yale Test Anxiety Scale scores, and into two treatment groups. The task was to find an imbedded figure. The two treatments consisted of administering the items in an order from easy to difficult and the second order was to administer the items from difficult to easy. Three scores were derived: latency, number of correct solutions, and a cautiousness index. It was found that high anxious subjects obtained higher cautiousness scores. High cautious subjects did better than low cautious subjects and the performance of high anxious subjects was superior to low anxious subjects at the low and middle intelligence range. The high anxious subject tends

to be more cautious and in situations where caution is an important factor tends to do better.

Anxiety and reasoning tasks were investigated by Buskirk (1961). Using college students as subjects, he administered three measures of manifest anxiety, two reasoning tasks, a logical deduction task, and a figure analogy task. The high manifest anxiety groups performed at a superior level on the complex logical deduction task. There were no differences between the groups on the other tasks. The investigator felt that the results of the study supported the interpretation that high anxious subjects have a stronger desire to do well as long as the situation does not present a serious threat to the ego.

The authors of the study dealing with perception and the one dealing with reasoning provide support for the contention that a high anxiety level may be facilitating in some instances provided that the situation is such that the performance called for does not involve elements which would lead to a threat to the subject.

The studies reviewed to this point have been mostly concerned with one type of performance in relation to anxiety. One situation which incorporates many of these specif- types of behavior is that of intelligence testing. The relationship of anxiety to performance on an intelligence test

is the core of this present study and, therefore, a few studies will be reviewed.

There have been a number of studies conducted to examine the interrelationship of anxiety and intelligence test performance. Hafner, Pollie, and Wapner (1960), administered the CMAS and the Weschler Intelligence Scale for Children (WISC) to subjects ages 10 through 12. There were no significant correlations between the intelligence quotients derived from the full scale and the verbal and performance subtest. Of the subscales, only block design and coding were significantly negatively correlated with the anxiety scores. In the total study, however, the authors report a negative correlation between manifest anxiety and WISC functioning.

The Otis Quick Scoring Mental Abilities Test was used by Keller and Rowley (1962). The Otis Test, the CMAS and the appropriate Metropolitan Achievement Test were administered to fourth, fifth and sixth grade children. The analysis indicated that anxiety and intelligence scores had a significant negative correlation only for sixth grade girls. That anxiety, as reflected by the particular scale used in the study, develops only after a number of years in the school setting was suggested but not supported by Zweibelson (1960) who used the Otis Alpha, Otis Beta, and the Davis Eells Games in his investigation of fourth grade

school children. He administered the TAQ and found that low anxious subjects do better than high anxious subjects regardless of the type of test used. Zweibelson found significantly greater negative correlations between the Otis test scores and TAS scores than between Davis-Eells scores and TAS scores. He indicated that the game-like quality of the Davis-Eells Games probably accounted for the lower negative correlation between the intelligence scores derived from that instrument and test anxiety scores.

Lighthall, Ruebush, Sarason, S. B., and Zweibelson (1959) used the Otis Beta and the Davis-Eells Games in their study of anxiety and mental ability. The Test Anxiety Scale for Children (TASC) was given to children in the fourth grade and the two intelligence measures were administered at the beginning of the fifth and again at the beginning of the seventh grade. Gain scores and mean scores for the two intelligence measures were analyzed. The subjects were divided at the median on the anxiety scale distribution. The high anxiety group was lower in terms of gain scores but the difference was not significant. When the mean scores on the two intelligence measures were compared as a function of anxiety, a significant effect of anxiety on performance was noted. The low anxiety group showed more gain on the Otis Beta while the high anxiety group showed more gain on the Davis-Eells Games.

Phillips (1962) administered the California Test of Mental Maturity along with achievement measures. Using the CMAS as a measure of anxiety, he found that high anxious subjects had lower intelligence scores than the low anxious group.

The Weschler Adult Intelligence Scale (WAIS), Raven's Progressive Matrices, the Bender-Gestalt and the Bender-Gestalt recall test were used by Siegman (1956). The MAS was administered to 35 medical and psychiatric patients along with the measures of intelligence. Correlations were obtained between the various measures. The low anxiety subjects' performance was superior to the high anxiety subjects' on Raven's Progressive Matrices, the Bender-Gestalt recall task and the timed sections of the WAIS. There were no significant differences in performance on the untimed sections of the WAIS or the Bender-Gestalt.

Performance on intelligence tests seems to be inversely related to anxiety. The influence of anxiety may be mediated by the format of the test and may be more of a factor when time limits are established.

Although there may be many other areas of performance which may be influenced by anxiety, the review of this section touches only those areas which were closely related to types of subject behavior required in the testing situation, particularly intelligence testing. In the studies

reviewed, it was indicated that anxiety may be a significant factor in verbal performance, achievement, learning, performance on numerical tasks, perceptual motor skills, concept formation, reasoning, and intelligence testing.

This chapter has presented a theoretical position on the origin of anxiety in the testing situation, a review of literature on the measurement of anxiety and a review of the literature on the effects of anxiety on performance. In the next chapter, the design of the study will be presented.

Chapter 3

Design of the Study

Subjects

The subjects for this study consisted of 160 pupils who were enrolled in the first grade of five public schools in Columbia, Missouri. To enter the first grade in Columbia, children must be six years of age by September 15th, therefore, during the eight months of data collection the subjects were six and seven years of age.

From the children enrolled in the schools, those with California Test of Mental Maturity (CTMM) total IQs between 100 and 125 were selected for this study. Most children responded to the CTMM during May of their kindergarten year. The exceptions were tested during the following September.

All subjects selected for this project were given an exposure to the testing situation in which a GSR recorder was attached and in operation prior to the administration of the intelligence test used in the study. While the recorder was attached, the Test Anxiety Scale for Children (TASC) and the General Anxiety Scale for Children (GASC) (Sarason, S. B., et al. 1960) were administered verbally by the examiner. This procedure served two purposes. First, it exposed the subjects to the elements of the testing sessions which

were to follow. Each child was allowed to respond to the examiner and to become familiar with the equipment. The procedure was employed to minimize the anxiety which might have been artificially imposed because of the novelity of the situation. Second, the TASC scores from the pretrial exposure provided a criterion for matching the experimental groups.

After all subjects were administered the TASC and the GASC, they were divided into four treatment groups of 40 subjects each and designated as Group I, II, III, and IV. Each group was composed of 20 boys and 20 girls whose mean CTMM IQs and mean TASC scores were very similar. The means may be found in Table 1. The appropriate t test was performed to determine if the differences observed between means were within chance fluctuations and the hypothesis of no significant differences was supported.

Table 1

Mean IQs and TASC scores for Experimental Group

(N = 40 in each group)

	CTMM	TASC
Group I	$\bar{X}$ 113.150	$\bar{X}$ 9.775
Group II	$\bar{X}$ 113.150	$\bar{X}$ 9.750
Group III	$\bar{X}$ 113.200	$\bar{X}$ 9.800
Group IV	$\bar{X}$ 113.150	$\bar{X}$ 9.800

The groups were thus matched on three variables: sex, IQs, and anxiety scores. These three variables were selected in order to control those factors which were observed to be related to anxiety in test situations described in the literature. The range of IQs from 100 to 125 was selected for two reasons. The first was to insure that all subjects would have some success on the individual intelligence test but none would have complete success, and the second was that the average or high average range of intelligence would provide a more stringent test of the hypothesis in the study since test anxiety does not seem to be as high in this range as others.

During the course of the investigation, five subjects were unable to complete the entire series of tests. Two subjects were lost to the study from both Group III and IV, and one was lost from Group II.

Fortunately a boy and a girl were lost from Group III and Group IV. This made necessary a rematching of the groups on the three original variables, so that the final data analysis was conducted on groups of 38 each, 19 boys and 19 girls. After eliminating two subjects from Group I and one from Group II, mean IQs and mean TASC scores were recomputed for each group and the appropriate t test was carried out. There were no significant differences found between the means on either variable. The mean CTMM IQs

and the mean TASC scores for the subjects used in the study are found in Table 2.

Table 2

Mean IQs and TASC Scores for Experimental Groups After Rematching

(N = 38 in each group)

	CTMM	TASC
Group I	113.816	9.868
Group II	112.736	9.368
Group III	113.816	9.763
Group IV	113.0263	9.711

Instruments and Apparatus

The Pictorial Test of Intelligence (PTI) was the point scale used in this study. The PTI is an individual test of general ability designed for administration by an examiner to one child at a time. It is a revision of the North Central Individual Test of Mental Abilities and was recently published by Houghton Mifflin Company. Questions are presented orally by the examiner in conjuction with large (11"x 11") picture cards on which are represented four possible choices or answers to the examiner's request. The child responds to the verbal instructions of the examiner by selecting one of four drawings on each card.

The test has no time limits and has 160 items arranged in six subtests. The subtests are: Picture Vocabulary, Form Discrimination, Information and Comprehension, Similarities, Size and Number, and Immediate Recall. While the subtests provide for the measurement of several different facets of mental functioning all subtests appear to be heavily loaded with "g."

The subject may make a response to the verbally posed requests of the examiner by pointing to the response card drawing which he considers to be correct.

A full description of the standardization data and the test items is found in the manual which accompanies the test (French, 1964). In order to acquaint the reader with the format of the test, a few sample items from each subtest are listed below:

Picture Vocabulary

V 1 Find the picture of the chair.

V 29 Find acquiring

Form Discrimination

F 2 Find the one that looks just like this.

F 24 Now find the one that can be finished to look just like this one.

Information and Comprehension

I 1a Find the one that cuts.

I 21 Find the picture that shows from what paper is made.

Similarities

S 1 Find the one that is not like the others.

Size and Number

N 3b Find the nest with the most eggs in it.

Immediate Recall

R 1 Find on this big card the picture that I just showed you.

The four orders of item placement gave basically four different forms of the PTI. These were: the published order, the absolute order, the random order, and the patterned order. A description of each form follows.

The published order of item arrangement was exactly as the test was published. The only change made was that special answer sheets were prepared for this study[1] and the items were numbered consecutively from 1 to 160. While the order of items in the other forms were changed, the assigned number from the published order was retained. A copy of the answer sheet used for the published order may be found in Appendix A along with the answer sheets for the other forms.

The absolute order of item arrangement consists of the items in ascending order of difficulty within each subtest.

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1 This study began before the PTI answer sheets were published.

The difficulty of each item was determined from the data received in the standardization of the PTI. Each item was subjected to an item analysis conducted on the responses made by all the subjects who attempted the item during the standardization. The arrangement of items in the absolute order is approximately the same as the published order but some differences do occur. These may be noted by referring to the answer sheet for this order which may be found in Appendix A.

The patterned order was composed by placing the items without regard to subtest. The two easiest items in the entire test were placed at the beginning of this form. They were followed by the hardest item. These three were followed by the next two easiest items and the next hardest item. This pattern of two easy items followed by one hard item was continued until all items were assigned positions. The level of difficulty of the easy items increased throughout the test while that of the hard items decreased. The difficulty of one easy and the hard item in the last sequence of three items was exactly the same. The one remaining item had the same difficulty level as the last two items in the previous sequence. In Appendix B the difficulty level of the items and the arrangement of the items in each form can be found.

It may be noted that there are only 137 response cards in the published test and 160 scorable responses. This difference occurs because some of the response cards are used more than once in a sequence of items. When the arrangement of items necessitated that this sequence of items be broken the response cards needed were photographically reproduced and placed in the proper position designated by that particular arrangement. Thus 160 response cards and items were used in all forms.

The second instrument used in this study was the PTI Behavioral Rating Scale. This scale was developed for use with the PTI by the test author and underwent several revisions before this study was undertaken. Although it was not designed specifically as an anxiety scale, the descriptions of behavioral patterns are some of those which may in general be used in a clinical description of behavior associated with anxiety within the testing situation. This scale differs from other psychometric instruments in that it provides a rating of observations during the test rather than before or after.

The PTI Behavioral Rating Scale is based on observed differences between two behavioral descriptions placed on either end of a five point rating continuum as used in the semantic differential approach. Each item is scored one

through five from the term on one side to the term on the other and the total rating score is obtained by summing the score for each item. This numbering procedure was established in order to eliminate zero or negative values for a total score.

The scale consists of 10 items which are basically observations of behavior and 14 items which are interpretations of the subject's reaction to the task and to the examiner. A copy of the entire PTI Behavioral Rating Scale may be found in Appendix C but four sample items appear below:

Must be told to look at cards	_ _ _ _ _	Studies cards carefully
Attention fixed on each card	_ _ _ _ _	Attention must be directed to many cards
Serious	_ _ _ _ _	Playful
Indifferent	_ _ _ _ _	Enthusiastic

The apparatus used in this study to record physiological behavior in terms of skin resistance was a Lafayette Multi-Purpose Polygraphy Recorder. The recorder has three paper drive speeds. The slowest drive speed, which was three inches per minute, was used in this study. The recorder was equipped with an oscillograph movement and an inking pen. An electrically operated impulser was also mounted in the recorder drive case.

The GSR amplifier is a balanced direct current amplifier with optional alternating current input coupling. Subject resistance was measured in a bridge circut, the subject appearing as one arm of the bridge and a calibrated potentiometer in the opposite arm.

In order to assure comparable readings in terms of the number of ohms of resistance per unit of pen deflection, the sensitivity potentiometer was calibrated at each five kilohms setting on the calibrated potentiometer or heliopot control. From this a regression equasion was obtained and the constant was added before each reading was made from the chart.

Calibration accuracy is a function of bridge source battery voltage. Before the study began it was found necessary to add an external voltmeter for checking the condition of the battery. If more than a five percent change was noted the battery was replaced. To eliminate another possible source of variance, the tubes in the amplifier were checked periodically and replaced when a loss of sensitivity was noted.

Finger electrodes were designed by the experimenter in order to assure constant contact with adjacent surfaces of the index finger of the subject's less preferred hand. The electrodes were zink disks one half inch in diameter and one sixteenth of an inch thick. The electrodes were

attached to flexible cartridge wire which was connected to the amplifier leads. The electrodes were then mounted on circular sponge rubber pads of the same diameter as the electrodes which were then mounted on a sponge rubber strip one half inch wide, one half inch thick, and one inch long. This assembly was attached to a flexible plastic strip one-half inch wide and one inch long.

In order to attach the electrodes securely and to provide as much comfort as possible while doing so, a cloth fastner which has the trade name of "Velcro" was used. The fastner has two sections. Each section has a relatively smooth backing and one of the sections has a fuzzed surface while the other has a surface consisting of minute plastic hooks. When the hooked surface of the one section is placed on the fuzzed surface of the other section, the hooks become imbedded within the fuzzed material and provide a suprisingly secure bond.

The width of fastner which was used in this electrode construction was one inch. The backing of the two sections were placed together in such a manner so that a one inch strip of the hooked section extended beyond the end of the fuzzed section. The two sections were then sewn together on a sewing machine.

The plastic strip of the electrode assembly was glued to the smooth backing of the hooked section. This placed

the fuzzed section next to the skin and held the electrodes against the palmar surface of the index finger.

The length of the fastner was sufficient to allow one and one half turns around the subject's finger. (See figure 1) This secured the electrode surface in such a manner that the hand could be moved without any apparent loss of contact. To assure maximum surface contact, the electrodes were curved to conform to the curvature of the finger.

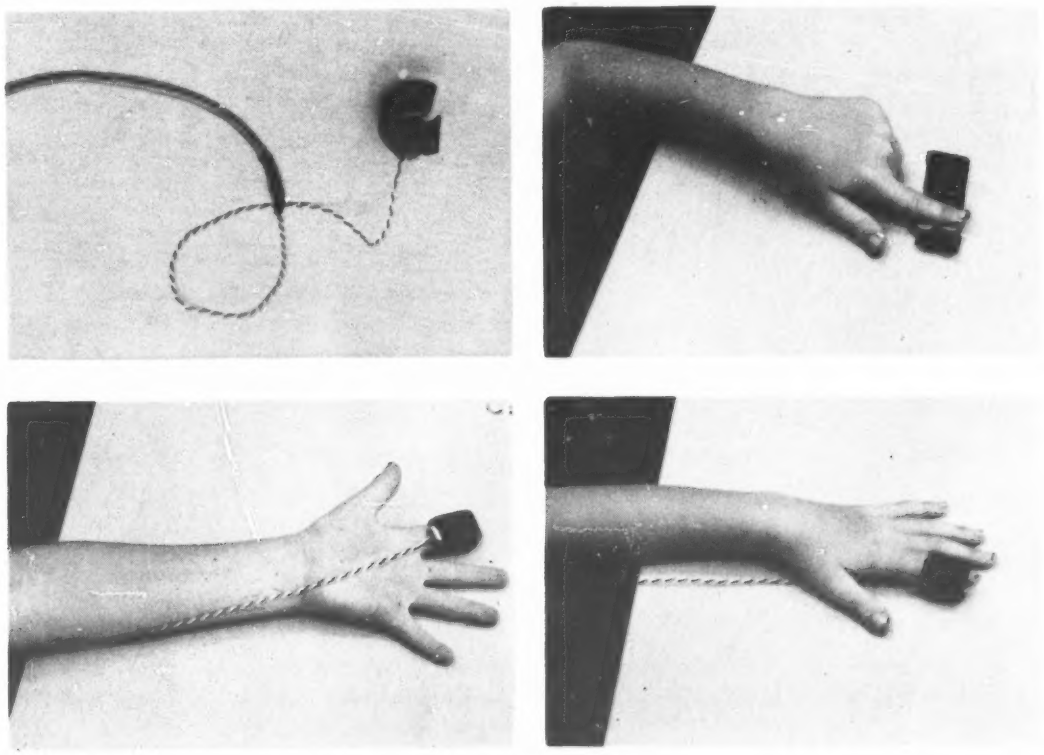

Fig. 1 Application of electrodes

To further insure a good contact, a zink sulfate electrode paste was made following the formula described by Lykken (1959, p. 634). The electrodes were cleaned after each use with a fine grain sandpaper to remove the oxidation and a thin coat of electrode paste was reapplied.

The subject's finger was cleaned before and after the attachment of the electrodes with alcohol to assure a clean skin surface. The procedure in the use of the above described electrodes and electrode paste was followed to reduce the measurement error as much as possible.

Method

The subjects were divided into four treatment groups as described previously. Each subject received each form of the PTI in a counter rotated order of administration. Subjects in Group I received the forms in the following order: published, random, absolute, and patterned. Group II subjects were administered the random order first followed by the absolute, patterned, and the published order. The order of administration to Group III was absolute, patterned, published, and random. Group IV received the patterned order first followed by the published, random, and absolute orders. This method of administration should remove any effects of sequence of testing with a particular form since no form was administered to more than one group of subjects first. A minimum of three and a maximum of six weeks elapsed between administrations of different PTI forms. The majority of subjects did not seem to be aware that the forms contained the same items. A few subjects stated that one or two items were like an item that was given before.